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CLAIMS

[Claim(s)]
[Claim 1] How to reuse the ablation wafer characterized by performing polish which removes a surrounding level difference to an ablation wafer at least as the aforementioned reprocessing in the method of adding reprocessing to the ablation wafer by which a byproduction is carried out in case a SOI wafer is manufactured by the hydrogen ion exfoliating method, and reusing as a silicon wafer.
[Claim 2] How to reuse the ablation wafer according to claim 1 characterized by carrying out finishing polish as the aforementioned reprocessing after the polish which removes a surrounding level difference.

[Claim 3] How to reuse the ablation wafer according to claim 1 or 2 characterized by removing a scaling film before the polish which removes a surrounding level difference as the aforementioned reprocessing.

[Claim 4] How to reuse the ablation wafer of a publication in any 1 term of the claim 1 characterized by performing donor killer heat treatment to an ablation wafer during the aforementioned rework, or a claim 3.
[Claim 5] How to reuse the ablation wafer characterized by reusing the ablation wafer reworked by any 1 term of the aforementioned claim 1 or a claim 4 by the method of a publication as a base wafer of a SOI wafer.
[Claim 6] How to reuse the ablation wafer characterized by reusing the ablation wafer reworked by any 1 term of the aforementioned claim 1 or a claim 4 by the method of a publication as a bond wafer of a SOI wafer.
[Claim 7] How to reuse the ablation wafer characterized by reusing the ablation wafer reworked by any 1 term of the aforementioned claim 1 or a claim 4 by the method of a publication as a silicon mirror-plane wafer.
[Claim 8] The silicon wafer with which the reuse characterized by being reworked by any 1 term of the aforementioned claim 1 or a claim 4 by the method of a publication is presented.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the method of adding reprocessing to the ablation wafer which exfoliates after combining the wafer which carried out the ion implantation, and manufactures a SOI (silicon on insulator) wafer and by which a byproduction is carried out in the so-called hydrogen ion exfoliating method (called the smart cutting method), and reusing as a silicon wafer.
[0002]
[Description of the Prior Art] It is the technology in which the joining-together method which combines conventionally what is depended on the SIMOX (separation by implanted oxygen) method which heat-treats at an elevated temperature and forms an oxide film after driving oxygen ion into a silicon single crystal by high concentration as a method of producing the wafer of SOI structure, and the silicon wafer of two sheets which carried out mirror polishing, without using adhesives, and thin-film-izes one of the two's wafer attracts attention.
[0003] since the SIMOX method can determine and control the thickness of the SOI layer used as a device active region by acceleration voltage at the time of oxygen ion implantation -- a thin layer -- and although there is an advantage which can obtain the high SOI layer of thickness homogeneity easily, the reliability of an embedding oxide film, the crystallinity of a SOI layer, and heat treatment at the temperature of 1300 degrees C or more are required -- etc. -- there are many problems
[0004] On the other hand, the wafer joining-together method forms an oxide film at least in one side between two silicon mirror-plane wafers of a single crystal. Join without using adhesives and combination is strengthened with subsequently adding heat treatment (usually 1100 degrees C - 1200 degrees C). Since mirror polishing of the front face of a thin film is carried out and a SOI layer is formed after thin-film-izing one of the two's wafer by grinding or wet etching after that, there is an advantage that the reliability of an embedding oxide film is high and the crystallinity of a SOI layer is also good.
[0005] However, since it has thin-film-ized by mechanical processing, and one of the two's wafer serves as powder etc. and time serious although thin-film-ized disappears to this top, productivity will be low and will become remarkable cost quantity. And in the grinding and polish by machining, there is a fault that there is a limitation also in the thickness of the SOI layer obtained and its homogeneity. in addition, not only when the wafer joining-together method combines silicon wafers, but a silicon wafer, SiO2 and SiC, and aluminum 2O3 etc. -- it may couple directly with an insulating wafer and a SOI layer may be formed
[0006] The method (the hydrogen ion exfoliating method : technology called smart cutting method) of exfoliating after combining the wafer which carried out the ion implantation as the manufacture method of a SOI wafer recently, and manufacturing a SOI wafer is newly beginning to attract attention. While this method forms an oxide film at least in one side among the silicon wafers of two sheets A hydrogen ion or a rare gas ion is poured in from the upper surface of one silicon wafer. After making a minute foam layer (enclosure layer) form in the interior of this wafer, the field of the direction which poured in

this ion is stuck with the silicon wafer of another side through an oxide film. It is the technology (refer to JP,5-211128,A) which adds the postheat treatment, exfoliates one wafer in the shape of a thin film by making a minute foam layer into a cleavage plane, adds heat treatment further, combines firmly, and is used as a SOI wafer. By this method, a cleavage plane is a good mirror plane and the SOI wafer also with the high homogeneity of the thickness of a SOI layer is obtained comparatively easily. and not only when combining silicon wafers also in this hydrogen ion exfoliating method, but a silicon wafer -- an ion implantation -- carrying out -- this, SiO2 and SiC, and aluminum 2O3 etc. -- it may couple directly with an insulating wafer and a SOI layer may be formed

[0007]

[Problem(s) to be Solved by the Invention] When a SOI wafer is produced by such hydrogen ion exfoliating method, the byproduction of the one ablation wafer of silicon will be carried out inevitably. Conventionally, since one SOI wafer was obtained from the silicon wafer of one sheet on parenchyma by reusing this ablation wafer that carried out the byproduction in the hydrogen ion exfoliating method, it was supposed that cost can be lowered sharply.

[0008] However, the example for which a certain thing actually reused reuse of such an ablation wafer as a concept was unknown in what [for there to be nothing and reuse how concretely]. In investigation of this invention persons, if especially the ablation wafer remained as it was, it turns out that a level difference is around a wafer, the damage layer by the ion implantation exists in a front face, or surface roughness is large so that it cannot be used as a usual silicon mirror-plane wafer. And when the ablation wafer has received heat treatment for ablation at least and CZ wafer is used, in the wafer, precipitation of oxygen may be started or resistivity may have separated sharply to the request value by generation of an oxygen donor.

[0009] Then, this invention was made in view of such a trouble, performs suitable reprocessing for the ablation wafer which carried out the byproduction in the hydrogen ion exfoliating method, offers a method actually reusable as a silicon wafer, and actually aims at aiming at a cost cut to improvement in the productivity of a SOI wafer.

[0010]

[Means for Solving the Problem] It is the method of reusing the exfoliation wafer characterized by invention indicated to the claim 1 of this invention in order to solve the above-mentioned technical problem performing polish which removes a surrounding level difference to an exfoliation wafer at least as the aforementioned reprocessing in the method of adding reprocessing to the exfoliation wafer by which a byproduction is carried out in case a SOI wafer is manufactured by the hydrogen ion exfoliating method, and reusing as a silicon wafer.

[0011] Thus, to the exfoliation wafer which carried out the byproduction by the hydrogen ion exfoliating method, it became clear that there is a level difference on the outskirts. Then, in this invention, it decided to remove by grinding a surrounding level difference as reprocessing of an exfoliation wafer. If polish removes the surrounding level difference of an exfoliation wafer, while a surrounding level difference is easily removable, removal of the damage layer of an exfoliation wafer front face and the improvement of surface roughness can also be made simultaneous.

[0012] In this case, as indicated to the claim 2, it is desirable as reprocessing of an exfoliation wafer to carry out finishing polish after the polish which removes a surrounding level difference. This is because the direction ground in two or more steps can make better surface roughness or flatness of a polished surface etc. rather than finishing a polished surface only by the polish which removes a surrounding level difference, and it can consider as a quality reuse wafer. And since there is not necessarily no need of also performing finishing polish in one step, you may carry out by two steps or more than it.

[0013] Moreover, as indicated to the claim 3, it is desirable to remove a scaling film as reprocessing of an exfoliation wafer before the polish which removes a surrounding level difference. Thus, if the scaling film is removed before the polish which removes a surrounding level difference, it can grind uniformly. That is, if the oxide film has adhered to the surrounding level difference section, it will turn to a bigger level difference up, and it will become difficult to grind an oxide film uniformly in polish, since silicon differs from a degree of hardness.

[0014] Moreover, invention indicated to the claim 4 of this invention is a method characterized by performing donor killer heat treatment to an exfoliation wafer during rework of an exfoliation wafer. Since the oxygen donor generated in the exfoliation wafer with exfoliation heat treatment etc. by performing donor killer heat treatment is eliminable, the resistivity anomaly of an exfoliation wafer can be lost.
[0015] Invention indicated to the claim 5 of this invention next, the exfoliation wafer reworked by any 1 term of the aforementioned claim 1 or a claim 4 by the method of a publication Are the method of reusing as a base wafer of a SOI wafer, and invention indicated to the claim 6 of this invention The exfoliation wafer reworked by any 1 term of the aforementioned claim 1 or a claim 4 by the method of a publication It is the method of reusing as a bond wafer of a SOI wafer, and invention indicated to the claim 7 of this invention is the method of reusing the exfoliation wafer reworked by any 1 term of the aforementioned claim 1 or a claim 4 by the method of a publication as a silicon mirror-plane wafer further.
[0016] Thus, since the front face is ground uniformly, the exfoliation wafer reworked by this invention can be used as the base wafer or bond wafer in the case of sticking the silicon wafer of two sheets and producing a SOI wafer, and can be used also as a usual silicon mirror-plane wafer. Since precipitation of oxygen has occurred with exfoliation heat treatment etc. in the reworked exfoliation wafer in using the exfoliation wafer by which the byproduction was especially carried out from CZ wafer as a base wafer or a usual silicon mirror-plane wafer, it will become suitable in order that this may demonstrate the gettering effect. Moreover, since there are no crystal defects, such as COP (CrystalOriginated Particle) and a precipitation-of-oxygen object, like CZ wafer in the case of the exfoliation wafer [wafer / FZ] which has the exfoliation wafer or epitaxial layer by which the byproduction was carried out, it is suitable to reuse as a bond wafer.
[0017] And invention indicated to the claim 8 of this invention is a silicon wafer with which the reuse characterized by being reworked by any 1 term of the aforementioned claim 1 or a claim 4 by the method of a publication is presented. As mentioned above, the exfoliation wafer reworked by this invention turns into a wafer reusable as a silicon wafer. In this case, what is necessary is to thicken thickness of the exfoliating near wafer which is beforehand used in the hydrogen ion exfoliating method, and just to make it become the thickness of the wafer considered as a request in reuse after rework by polish.
[0018]
[Embodiments of the Invention] Although the form of operation of this invention is explained hereafter, referring to a drawing, this invention is not limited to these. Here, drawing 1 is the flow view showing an example of the manufacturing process of the SOI wafer by the method of manufacturing a SOI wafer by the hydrogen ion exfoliating method. Moreover, drawing 2 is the process flow view showing an example of the method of reworking and reusing the exfoliation wafer of this invention.
[0019] Hereafter, this invention is explained focusing on the case where the silicon wafer of two sheets is combined. First, in the hydrogen ion exfoliating method of drawing 1 , at a process (a), two silicon mirror-plane wafers are prepared and the bond wafer 2 used as the base wafer 1 used as the pedestal suitable for the specification of a device and a SOI layer is prepared. Next, at a process (b), one [at least] wafer of them is oxidized thermally, the bond wafer 2 is oxidized thermally here, and the oxide film 3 of about 0.1 micrometers - 2.0 micrometer ** is formed in the front face.
[0020] Inject a hydrogen ion or a rare gas ion into a front face to one side of the bond wafer 2 in which the oxide film was formed, the minute air-bubbles layer (enclosure layer) 4 parallel to a front face is made to form in it in the average penetration depth of ion at a process (c), and this pouring temperature has desirable 25-450 degrees C. A process (d) is a process which piles up and sticks the base wafer 1 to the hydrogen ion pouring side of the bond wafer 2 which carried out hydrogen ion pouring through an oxide film, and wafers paste it up by contacting the front faces of two wafers under atmosphere with pure ordinary temperature, without using adhesives etc.
[0021] Next, a process (e) is an exfoliation heat treatment process divided into the exfoliation wafer 5 and the SOI wafer 6 (SOI layer 7+ pad oxide-film 3+ base wafer 1) by exfoliating bordering on the

enclosure layer 4, for example, if heat treatment is added at the temperature of about 500 degrees C or more under inert gas atmosphere, it will be divided into the exfoliation wafer 5 and the SOI wafer 6 by the rearrangement of a crystal, and condensation of air bubbles.

[0022] And at a process (f), in the bonding strength of the wafers stuck at the adhesion process and exfoliation heat treatment process of the aforementioned process (d) and (e), since it is weak for using it at a device process as it is, as heat-of-linkage processing, hot heat treatment is performed to the SOI wafer 6, and let a bond strength be sufficient thing. It is desirable to perform this heat treatment in 2 hours from 30 minutes at 1050 degrees C - 1200 degrees C for example, under inert gas atmosphere. In addition, exfoliation heat treatment of a process (e) and heat-of-linkage processing of a process (f) may be performed continuously, and exfoliation heat treatment of a process (e) and heat-of-linkage processing of a process (f) may be performed as that as which it serves simultaneously.

[0023] Next, a process (g) is a process of very few mirror polishing of the polish cost called touch polish, and is a process which removes removal and surface roughness of the crystal-defect layer which exists in the cleavage plane which is a front face of the SOI layer 7. The quality SOI wafer 6 with which crystal quality is high with the wafer and has the high SOI layer 7 of thickness homogeneity through the above process can be manufactured (process (h)).

[0024] In such a hydrogen ion exfoliating method, the byproduction of the exfoliation wafer 5 will be carried out in the drawing 1 (e) process. Since the SOI layer thickness produced by the hydrogen ion exfoliating method is usually it 2 microns or less that it is thick in about 0.1-1.5 microns, the exfoliation wafer 5 has sufficient thickness. Therefore, if this is reused as a silicon wafer, it will become possible to lower the manufacturing cost of a SOI wafer remarkably.

[0025] However, as the extention mimetic diagram of an exfoliation wafer was shown in drawing 2 (A), the level difference 10 occurred in the periphery of this exfoliation wafer 5, and if it remained as it is, the thing and bird clapper which cannot be used as a silicon wafer were found. Without combining the periphery of a bond wafer with a base wafer, the level difference 10 of the circumference of this is generated from a bird clapper as it is uncombined. Therefore, the height of this level difference becomes the thing of a grade which embedded with SOI layer thickness and added the thickness of an oxide film 3.

[0026] Moreover, in the surface of separation 11 of an exfoliation wafer, the damage layer 12 by hydrogen ion pouring remained, and it turns out at it that it is bad compared with a mirror-plane wafer usual also in the surface roughness. When local surface roughness was bad and gave etching with selectivity like alkali etching especially, it turns out that a deep pit will be formed.

[0027] Furthermore, this exfoliation wafer 5 has received exfoliation heat treatment of about 500 degrees C or more at least, and it may produce un-arranging, as an oxygen donor occurs and resistance of a wafer indicates outlying observation to be, when the wafer containing oxygen like CZ wafer is used as a bond wafer.

[0028] Then, that the above problems should be solved, this invention persons perform suitable reprocessing for the exfoliation wafer which carried out the byproduction in the hydrogen ion exfoliating method, and as a result of examining how to actually reuse as a silicon wafer, they result in this invention. That is, first, by this invention, when manufacturing a SOI wafer by the hydrogen ion exfoliating method, polish removed the level difference of the circumference produced to the exfoliation wafer by which a byproduction is carried out.

[0029] Thus, if polish removes the surrounding level difference of an exfoliation wafer, a surrounding level difference is easily removable. For example, when SOI layer thickness is 0.2 microns, a level difference can be completely removed by about 1-micron polish cost. And in case polish removes a surrounding level difference, removal of the damage layer of an exfoliation wafer front face and the improvement of surface roughness can also be performed simultaneously.

[0030] In this case, as reprocessing of an exfoliation wafer, it is desirable to carry out finishing polish after the polish which removes a circumference level difference. This is because the direction ground in two or more steps using abrasives with a more fine eye can make surface roughness, flatness, etc. of a polished surface better rather than finishing a polished surface only by the polish which removes a

surrounding level difference, and quality equivalent to the surface roughness of the usual silicon mirror-plane wafer or flatness can be attained. In addition, there is not necessarily no need of also performing this finishing polish in one step, and it may be performed by two steps or more than it.

[0031] Moreover, in this invention, it is desirable to remove the scaling film 3 as reprocessing of an exfoliation wafer before the polish which removes a surrounding level difference. This is because the direction which removes the scaling film 3 before the polish which removes the surrounding level difference 10 can grind uniformly. That is, it is because a level difference will become higher, and the inside of an exfoliation wafer side will become is hard to be ground uniformly as for an oxide film since silicon differs from a degree of hardness, if the oxide film 3 has adhered to the surrounding level difference section 10. Removal of an oxide film can perform an exfoliation wafer easily by being immersed into fluoric acid.

[0032] In this way, the damage layer by the level difference in an exfoliation wafer periphery and hydrogen ion pouring in the surface of separation and the surface roughness of the surface of separation can be removed, and a reuse wafer with the front face which any inferiority does not have compared with the usual mirror-plane wafer can be obtained.

[0033] Moreover, when an exfoliation wafer is a CZ wafer in this invention, it is desirable to perform donor killer heat treatment during rework of an exfoliation wafer. Since an exfoliation wafer exfoliates with exfoliation heat treatment of about 500 degrees C or more, it will have received such [naturally] low-temperature heat treatment. If low-temperature heat treatment is performed to the silicon wafer which contains oxygen like CZ wafer, an oxygen donor will occur, for example, it is known well that phenomena, like the resistivity of p type silicon wafer becomes high unusually may arise. Therefore, also in the exfoliation wafer by which a byproduction is carried out by the hydrogen ion exfoliating method, an oxygen donor arises with exfoliation heat treatment, and a bird clapper has the resistivity of an exfoliation wafer unusually. for this reason -- for example, in case the thickness of a wafer is measured, the problem that thickness of an exfoliation wafer cannot be measured with the measuring instrument of the capacitive sensing method currently generally used arises

[0034] Therefore, in this invention, by performing donor killer heat treatment during rework, the oxygen donor generated in the exfoliation wafer is eliminated, and the resistivity anomaly of an exfoliation wafer was lost with exfoliation heat treatment etc. What is necessary is just made to carry out heat treatment for 20 minutes as a method which should just add heat treatment of 600 degrees C or more, and is commonly used as this donor killer heat treatment as generally carried out, for example at 650 degrees C.

[0035] And during rework of an exfoliation wafer, before that washing or etching of a wafer is performed heat-treats as mentioned above many especially, washing and etching are performed in many cases so that a wafer may not be polluted in heat treatment. In this case, since a cure, such as a deep pit being formed and making [many] polish cost at a next polish process, is needed when etching or washing with selectivity like alkali etching is performed, since local surface roughness is bad and also has a damage layer, an exfoliation wafer like this invention is not desirable.

[0036] In this way, since it has the completely same field state as the usual silicon mirror-plane wafer ground uniformly, the silicon wafer reworked by the method of the above-mentioned this invention can be used as a raw material wafer of a lamination SOI wafer, and may be used as a silicon wafer for production of the usual integrated circuit etc. Moreover, you may use as the so-called substrate of an epitaxial wafer, and especially the use of the reuse is not limited.

[0037] In this case, into the reworked exfoliation wafer, in using the exfoliation wafer with which this invention was reworked as a base wafer or a usual silicon mirror-plane wafer, since precipitation of oxygen has occurred with the thermal-oxidation processing before hydrogen ion pouring (usually 900 degrees C or more), and exfoliation heat treatment of about 500 degrees C or more, in order that this may demonstrate the so-called in thorin chic gettering effect (the IG effect), it will become suitable. Moreover, if an exfoliation wafer is used as the base wafer or bond wafer at the time of producing a SOI wafer, since one SOI wafer can be obtained from the silicon wafer of one sheet on substance, the manufacturing cost of a SOI wafer can be decreased remarkably.

[0038] In addition, although the ablation wafer reworked by this invention is reused as a desired silicon wafer, it thickens thickness of the bond wafer which is an exfoliating near wafer which is beforehand used in the hydrogen ion exfoliating method a little from the thickness for which it is needed with a reuse wafer, and it is made to serve as thickness of the wafer considered as a request in reuse after rework by polish.
[0039] However, even if it can remove a level difference completely by about 1 micron [at most] polish cost and performs washing accompanied by subsequent finishing polish and etching etc. as mentioned above although based also on SOI layer thickness in order to remove the surrounding level difference of an exfoliation wafer by polish by this invention, a machining allowance 10 microns or less is enough on the whole. Thickening thickness of the bond wafer to be used beforehand also seems therefore, not to become a problem.
[0040]
[Example] Although the example of this invention is given and being explained concretely hereafter, this invention is not limited to these. (Example) The conductivity type manufactured [resistivity] the SOI wafer with p type by the hydrogen ion exfoliating method 20 ohm-cm and the diameter followed the process shown in drawing 1 (a) - (h) using the silicon mirror-plane wafer which is 150mm. The thing thick about 8 microns was used for the thickness of the bond wafer 2 by the average of the thickness of the base wafer 1. SOI layer thickness considers as 0.2 microns, in addition the main conditions, such as an ion implantation, are as follows.
1) Pad oxidization thickness : 400nm (0.4 microns) 2 hydrogen pouring conditions: H+ Ion, pouring energy 69keV Pouring dosage 5.5x1016-/cm2 3 exfoliation heat-treatment conditions: N2 Bottom of gas atmosphere, and 500 degree-Cx 30 minutes 4 heat-of-linkage processing conditions: N2 The bottom of gas atmosphere, 1100 degree-Cx2 hour [0041] In this way, although the quality SOI wafer which has a SOI layer with a thickness of 0.2 microns was producible, the byproduction of the exfoliation wafer 5 was carried out at the process (e) of drawing 1 . It decided to add reprocessing according to process [of drawing 2] (A) - (G), and to reuse this exfoliation wafer as a base wafer.
[0042] First, the unsettled circumference configuration of the exfoliation wafer 5 of drawing 2 (A) was measured by carrying out a scan with a sensing-pin formula granularity plan. The measurement result was shown in drawing 3 (A). In the periphery of the exfoliation wafer 5, the level difference 10 resulting from the portion which became uncombined in the circumference at the time of lamination has arisen so that clearly from this drawing. And the height of the level difference 10 of the circumference of it understands beyond the value grade that applied SOI layer thickness (0.2 microns) and the thickness (0.4 microns) of an oxide film, and a bird clapper.
[0043] Moreover, when the surface roughness of the surface of separation 11 of the unsettled exfoliation wafer 5 of drawing 2 (A) was measured on the 250-micron square by the phase shift interferometer method and it measured on the 1-micron square by the atomic force microscope method, they were an average of 0.43nm and 8.3nm in the RMS value (square mean square solution granularity), respectively. This value is a value very worse than the surface roughness of the usual silicon wafer by which mirror polishing was carried out, and especially the value in a 1-micron angle is a value of 10 usual times or more, and understands that local ****** is large for the surface of separation.
[0044] Next, in drawing 2 (B), the surface oxide film 3 was removed by immersing an exfoliation wafer into fluoric acid. Fluoric acid was made into HF50% solution. And it measured by carrying out the scan of the circumference configuration of an exfoliation wafer where the oxide film was removed, with a sensing-pin formula granularity plan again, and the result was shown in drawing 3 (B). It turns out that the level difference [a little] higher than SOI layer thickness (0.2 microns) has arisen at the periphery of the exfoliation wafer 5 so that clearly from this drawing.
[0045] Next, in drawing 2 (C), washing before heat treatment was carried out so that an exfoliation wafer might not be polluted. This washing performed two-step washing of (the ammonia/hydrogen peroxide solution), and (a hydrochloric acid/hydrogen peroxide solution) widely known as the so-called RCA washing. At this time, it is made not to perform the so-called alkali cleaning with the etching operation of an anisotropy powerful as mentioned above using caustic alkali of sodium etc.

[0046] And if washing before heat treatment finished, after measuring the resistivity of an exfoliation wafer, donor killer heat treatment was performed to the exfoliation wafer (drawing 2 (D)). Heat treatment conditions were set as for 20 minutes at 650 degrees C. The resistivity of an exfoliation wafer was again measured after heat treatment. Consequently, it was set to 20-ohmcm that whose the rear-face resistivity of an exfoliation wafer was 400-500-ohmcm, and surface resistivity was more than 3000-ohmcm it is the resistivity of the beginning [rear face / front] after donor killer heat treatment in the measurement before heat treatment.

[0047] Next, in drawing 2 (E), polish which removes a surrounding level difference to the exfoliation wafer which donor killer heat treatment ended was performed. What is necessary is just to make polish be the same as that of the equipment and the conditions which grind the usual silicon wafer. It is 500 g/cm2, putting an exfoliation wafer between vertical surface plates, and rotating reversely a surface plate mutually by 50rpm in this invention. The surface of separation was ground supplying a polish slurry to a polished surface having applied the load.

[0048] At this time, the result which investigated the relation between the machining allowance of polish and the height of a surrounding level difference was shown in drawing 4 . This drawing shows that a surrounding level difference is fully removable, if 1 micron is also ground as polish cost.

[0049] Moreover, it measured by carrying out the scan of the circumference configuration of the exfoliation wafer which carried out surrounding level difference removal polish of polish cost 5 Miquelon with a sensing-pin formula granularity plan again, and the result was shown in drawing 3 (C). It turns out that the level difference of the periphery of an exfoliation wafer is removed finely, and it has become a circumference configuration reusable enough as a silicon wafer so that clearly from this drawing.

[0050] Finally, in drawing 2 (F), finishing polish was performed and reprocessing of an ablation wafer was ended. It finishes with surrounding level difference removal polish, and the machining allowance by polish by the whole polish was made to become about 8 microns at this time. And when the surface roughness of the polished surface after finishing polish (surface of separation) was measured on the 250-micron square by the phase shift interferometer method and it measured again on the 1-micron square by the atomic force microscope method, they were an average of 0.25nm and 0.19nm in the RMS value (square mean square solution granularity), respectively. While this value is equivalent to the surface roughness of the usual silicon wafer by which mirror polishing was carried out and it turns out that the remarkable improvement was achieved, it turns out that this reworked ablation wafer is a thing reusable as a silicon wafer.

[0051] Then, in this example, the reworked ablation wafer was used as a base wafer like drawing 2 (G). That is, the reuse wafer was used as a base wafer 1 of drawing 1 (a). Since 8 microns of ablation wafers were thickened from the first, the thickness after rework is the request thickness of the base wafer used by drawing 1 (a). the place which produced the SOI wafer by the hydrogen ion exfoliating method according to the process of drawing 1 after that -- the quality SOI wafer of a passage was usually producible satisfactory

[0052] In addition, this invention is not limited to the above-mentioned operation gestalt. The above-mentioned operation gestalt is instantiation, and no matter it may be what thing which has the same composition substantially with the technical thought indicated by the claim of this invention, and does the same operation effect so, it is included by the technical range of this invention.

[0053] For example, although explained focusing on the case where combine the silicon wafer of two sheets above and a SOI wafer is produced, it is not limited in this case and combines with an insulating wafer after an ion implantation at a silicon wafer, and naturally this invention can be applied, when adding reprocessing to the ablation wafer which carries out a byproduction when exfoliating a silicon wafer and manufacturing a SOI wafer.

[0054] Moreover, it is not limited to what was shown in drawing 2 , and other processes, such as washing and heat treatment, may be added to this process, or exchange of the order of a process, an ellipsis, etc. can also carry out the reprocessing steps of the ablation wafer of this invention to it suitably according to the purpose in part.

[0055]
[Effect of the Invention] As explained above, according to this invention, suitable reprocessing can be performed to the ablation wafer which carried out the byproduction in the hydrogen ion exfoliating method, and it can actually reuse now as a silicon wafer to it. That is, by this invention, the level difference of the wafer circumference which poses a problem with an ablation wafer, the damage layer by the ion implantation, and surface roughness can be removed, and the problem of the abnormalities in resistivity by the generation of an oxygen donor based on ablation heat treatment can also be eliminated. Therefore, a cost cut can be aimed at with improvement in the remarkable productivity of a SOI wafer.

[Translation done.]